APPLICATIONS OF SIMULATION AND QUEUING THEORY IN SCOOTER INDUSTRY

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Abstract

This paper describes the role of queuing theory in developing queuing networks in companies. Queuing networks can be considered as a collection of nodes where each node stands for a service facility. It is a powerful and versatile tool for modeling facilities in manufacturing products. In the realm of service industries like scooter manufacturing, the queuing theory and simulation play a vital role. These concepts help in predicting queue lengths and waiting durations when multiple scooters are manufactured and distributed using first come first serve discipline. Tables are used to explore the availability of furnished scooters in the companies and their comparative study analyzes the waiting scooters and space availability in the companies.

Keywords: Queue network, space availability, service facility, simulation and production analysis.

I. Introduction

Most works on queuing models are restricted to deriving the formulations for transient or stationary states. The past study has not paid much attention to the analysis of queuing systems in the directions such as waiting times and space availability. Frequently, some information about the distribution of scooters in lorry and number of waiting scooters is analyzed with the help of simulation. Generally, simulation is the representation of reality through the use of a model/device which will react in the same manner as reality under a given set of conditions such as testing the performance of a scooter under different conditions.

Baskett et al. [1] analyzed the different networks of queues under different classes of customers using joint equilibrium distribution. Reddy et al. [11] evaluated the queue system with multiple vacations and a server leaves for a vacation of random length when the queue length is less than requirement. Divya and Indhira [6] threw light on the queuing model with working vacation where during the vacation period, the server provides service at a slower pace. Baba [16] evaluated the queue model with multiple working vacations where the server works with different rates. Chakravarthy [4] examined a single server stochastic queue model with Markovian arrivals and impatient customers where customers can become impatient after waiting a random amount of time.

Chinwuko et al. [3] analyzed the effects of queuing theory in a banking system with first come first serve discipline where the organization needs five servers instead of three available servers. Igwe et al. [2] evaluate the performance of queue management in supermarkets subject to average service rate using first come first serve descipline. Roy and Sinha [12] examined the effects of internet banking on customer acceptance of electronic payment systems where credit card and debit card provide variety of services to the customers. Zhang and Liu [9] analyzed the queue with server breakdown, working vacations and vacation interruption using the supplementary variable method.

Rajadurai [15] analyzed the sensitivity of a retrial queuing system with disasters under working vacations where a system may become defective by disasters at any point of time under availability of a regular server. Saraswat [7] evaluated the effects of a single counter Markovian queuing model with multiple inputs. Bura [8] examined the M/M/∞ queue subject to impatient customers where customers are impatient due to low quality of service. Chakravarthy and Kulshrestha [13] described a queuing model with backup server in the absence of the main server to continued the process.

Agrawal et al. [10] described the steady state probability distribution of a queuing model with working vacation under two types of server breakdown using first come first serve discipline. Narmadha and Rajendran [14] analyzed the queuing network through many developments which made its existence in many fields. Daş et al. [5] described the fluctuation in the participation of companies and two stage stochastic industrial networks under uncertain demand.

The production of two scooter companies is analyzed with simulation to calculate the number of waiting scooters and available space. It is considered that both companies have the same production per day but have different probability values and random number values. Tables are used to explore the availability of furnished scooters in the companies and their comparative study analyzes the waiting scooters and space availability in the companies.

II. Assumptions

To describe the performance of the scooter industry, there are following assumptions

- There are two scooter companies such that company (A) and company (B).
- It is considered that companies (A) and (B) may produce 150 scooters.
- The daily production varies from 146 to 154.
- The probabilities of production per day of both companies are different.
- The average number of scooters waiting in the factory and average number of available spaces in the lorry are analyzed by using simulation.

III. Descriptions of Company (A) and (B)

(I) Analysis of Scooter Company (A)

A scooter company (A) manufactures 150 scooters. The daily production varies from 146 to 154. Now, it is observed that

Table 1: *Production per day of company (A)*

Production Per Day	146	147	148	149	150	151	152	153	154
Probability	0.04	0.09	0.12	0.14	0.11	0.10	0.20	0.12	0.08

Then the furnished (or tested good position) scooters are transported in a lorry accordingly 150 scooters using the following random variables,
X=80, 81, 76, 75, 64, 43, 18, 26, 10, 12, 65, 68, 69, 61, 57.
Then simulate the following:
(i) Average number of scooters waiting in the factory.
(ii) Average number of available space in the lorry.

Solution. From the given data, get

Table 1.1: *Probability Distribution of Company (A)*

Production	Probability	Cumulative Probability	Random Number
146	0.04	0.04	0-3
147	0.09	0.13	4-12
148	0.12	0.25	13-24
149	0.14	0.39	25-38
150	0.11	0.50	39-49
151	0.10	0.60	50-59
152	0.20	0.80	60-79
153	0.12	0.92	80-91
154	0.08	1.00	92-99

Table 1.2: *Number of waiting Scooter and Available Space in lorry of Company (A)*

Sr. No.	Random No.	Production Per Day	No. of Scooters Waiting	No. of available Space in Lorry
1	80	153	3	
2	81	153	3	
3	76	152	2	
4	75	152	2	
5	64	152	2	
6	43	150		
7	18	148		2
8	26	149		1
9	10	147		3
10	12	147		3
11	65	152	2	
12	68	152	2	
13	69	152	2	
14	61	152	2	
15	57	151	1	
			Sum=21	Sum=9

Here, production per day is calculated from (Table-1.2).
So, (i) Average number of scooters waiting in the factory=21/15.
(ii) Average number of available space in the lorry=9/15.

(II) Analysis of Scooter Company (B)

A scooter company (B) manufactures 150 scooters. The daily production varies from 146 to 154. Now, it is observed that

Table 2: *Production per day of company (B)*

Production Per Day	146	147	148	149	150	151	152	153	154
Probability	0.05	0.08	0.10	0.16	0.10	0.08	0.20	0.15	0.08

Then the furnished (or tested good position) scooters are transported in a lorry accordingly 150 scooters using the following random variables,
X=95, 70, 60, 85, 65 48, 25, 15, 10, 18, 75, 78, 87, 65, 54.
Then simulate the following:
(i) Average number of scooters waiting in the factory.
(ii) Average number of available space in the lorry.
Solution. From the given data, get

Table 2.1: *Probability Distribution of Company (B)*

Production	Probability	Cumulative Probability	Random Number
146	0.05	0.05	0-4
147	0.08	0.13	5-12
148	0.10	0.23	13-22
149	0.16	0.39	23-38
150	0.10	0.49	39-48
151	0.08	0.57	49-56
152	0.20	0.77	57-76
153	0.15	0.92	77-91
154	0.08	1.00	92-99

Table 2.2: *Number of waiting Scooter and Available Space in lorry of Company (B)*

Sr. No.	Random No.	Production Per Day	No. of Scooters Waiting	No. of Available Space in Lorry
1	95	154	4	
2	70	152	2	
3	60	152	2	
4	85	153	3	
5	65	152	2	
6	48	150		
7	25	149		1
8	15	148		2
9	10	147		3
10	18	148		2
11	75	152	2	
12	78	153	3	
13	87	153	3	
14	65	152	2	
15	54	151	1	
			Sum=24	Sum=8

Here, production per day is calculated from (Table-1.4).
So, (i) Average number of scooters waiting in the factory=24/15.
(ii) Average number of available space in the lorry=8/15.

IV. Discussion

From tables 1.1 and 1.2 it is clear that the number of scooters waiting (21) is more than the available spaces (9) in lorry. So, it is concluded that the number of production is more than the available space in lorry. From tables 2.1 and 2.2 it is clear that the number of scooters waiting (24) is more than available space (8) in the lorry. So, it is concluded that the number of production is more than the available space in lorry.

V. Conclusion

From tables, it is concluded that the average number of waiting scooters in company (A) is less than the average number of waiting scooters in company (B). Thus, the production of scooters in company (B) is more than the production of company (A).

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